Sustainability: The Next Step
Estimating the University of Wisconsin – Green Bay's Carbon Footprint

Chapter 2
Scope 2 – Indirect Emissions

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Introduction

An integral facet of the foundation necessary to develop a plan to reduce greenhouse gas emissions from UW-Green Bay is a greenhouse gas inventory. The ACUPCC allows the use of any methodology consistent with the standards of the Greenhouse Gas Protocol developed by the World Business Council for Sustainable Development and the World Resources Institute (ACUPCC 2007). For the purpose of this research, we are using the Campus Carbon Calculator developed by Clean Air Cool Planet.

The ACUPCC has separated the sources of carbon emissions into three "scopes." The second scope is the focus of this chapter and identifies indirect emissions from the production of electricity consumed by UW-Green Bay. Specifically, this category…"accounts for indirect GHG emissions from the generation of purchased electricity consumed by equipment or operations owned or controlled by the institution" (ACUPCC 2007). This inventory reaches back to the 2000-2001 school year, or the 2001 fiscal year based on the UW budget. All properties owned by UW-Green Bay were evaluated as well as the on-campus dormitories and apartments. These housing facilities are managed by the UW-Green Bay's Office of Residence Life. Because of the integral connection with the university, as well as fact they are physically located on university property, these buildings were included in the inventory.

Campus electrical usage was procured through contact with Chris Hatfield, Director of Facilities Management and Planning, UW-Green Bay. Mr. Hatfield provided Microsoft Excel spreadsheets detailing all university usage for fiscal years 2000-2007.

Residence Life provided electrical usage for the dormitories and apartments from 2002 through 2007 and was procured through contact with Steve Gering, Assistant Director for Facilities Operations, Office of Residence Life.

Mr. Gering also provided input into the programs Residence Life has developed in an effort to reduce the electrical, natural gas and water usage by the housing facilities under its jurisdiction. As an example, each semester dormitories have energy contests to see which building can reduce energy usage per student the most. Winners receive ice cream socials or free Star Bucks Coffee.

Electricity use by both UW-Green Bay and Residence Life is generated from Wisconsin Public Service (WPS). WPS provides electricity to over 400,000 customers from a variety of sources including fossil fuel, nuclear, wind, and hydroelectric generating plants. Coal-fired power plants account for 65 percent of electricity followed by 15 percent from nuclear power and 4 percent from combustion turbine, hydroelectric, and renewable resources. The remaining 16 percent is purchased from other utilities (WPS 2007).

From a structural point of view, UW-Green Bay has 15 major buildings that consume the majority of electricity used on campus. Ancillary buildings include the Shorewood Golf Course Pro Shop and shed, Lambeau Cottage, Kingfisher Farm, the Language House, the Chancellor's house, and several signs. Electrical usage from these facilities is recorded in kilowatt hours (kWh) (Hatfield 2007).

Residence Life operates and maintains 28 building and residences. All exit lights in these buildings are LED technology. All lighting is T-8 florescent lights with electronic ballasts. Facility laundry rooms and lounges have proximity sensors as a strategy to reduce electrical costs when no one is present. If these sensors do not detect movement after a specified period of time, the lights in the area automatically go off. In addition, most electrical contactors set a goal of two watts of lighting per square foot in living facilities. Fifty percent of the lights in these living facilities at UW-Green Bay have been removed to maintain one watt per square foot. This cuts the electrical usage from lighting in half (Gering 2007).

Residence Life has implemented several strategies for water and energy savings. Low flow toilets have been installed to reduce water consumption. Traditional washing machines that use approximately 45 gallons of water per load have been replaced with low flow machines that use a maximum of 12 gallons of water per load. In addition, these new washing machines spin at a higher rpm to ring out more water during the spin cycle. This leaves less water for the dryer to remove and reduces electrical consumption (Gering 2007).

Data Collection

Chris Hatfield provided Microsoft Excel spreadsheets detailing electrical usage for the UW-Green Bay campus from 2001-2007. This information is found in Appendix 2. Total electrical usage for the fiscal year was used in the Campus Carbon Calculator. UW-Green Bay's fiscal year begins on July 1 and ends on June 30 of the following year. For simplicity, any given fiscal year is referred to as the year the fiscal year ends. For example, fiscal year 2006-2007 is referred to as 2007.

Steve Gering provided printed spreadsheets detailing the electrical usage for Residence Life apartments and dormitories from 2002-2007. This information is summarized in Appendix 3. Total electrical usage for the fiscal year was used in the Campus Carbon Calculator. The fiscal year for Residence Life is based on a calendar year. 2007 data is only complete through October 15. An extrapolation of this number through the end of 2007 was used in all calculations. In addition, electrical usage for 2001 had to be estimated. Based on the electrical usage from the UW-Green Bay campus, 2001 usage was 94.12 % of 2002 usage. Therefore, the same multiplier was used for Residence Life and estimates the 2001 electrical usage at 1,356,818 kWh.

Results

Table 2.1 shows the amount of electricity consumed at UW-Green Bay since 2001. These numbers include all campus buildings, campus managed buildings, residence life buildings, and has some wastewater data incorporated.

Table 2.1. Amount of electricity consumed by UW-Green Bay

Year	kWh consumed
2001	16,826,869
2002	17,880,023
2003	19,127,336
2004	19,805,095
2005	21,296,197
2006	21,621,005
2007	19,586,921

According to the CA-CP calculator, the University has contributed an average of 16,979 metric tons of equivalent carbon dioxide emissions per year to the atmosphere since 2001. This number is the average emissions from the generation of electricity consumed at UW-Green Bay. The amount of electricity consumed peaked at 21,621,005 kWh in fiscal year 2005-2006, and dropped to 19,586,921 kWh during fiscal year 2006-2007. The emissions from electricity generation will obviously follow this same trend, and table 2.2 shows this. Table 2.2 shows the corresponding equivalent carbon dioxide emissions, in metric tons, from the electricity purchased from WPS. This table also shows the amount of people on campus during this time period, which includes full-time students, part-time students, faculty, and staff members.

Table 2.2. Number of people on campus, amount of equivalent carbon dioxide emissions from purchased electricity at UW-Green Bay, and emissions from purchased electricity per person

Year	**Number of people on campus**	**eCO_2 emissions from purchased electricity (metric tons)**	**eCO_2 emissions per person (metric tons)**
2001	6,047	14,690	2.43
2002	5,921	15,609	2.64
2003	5,902	16,698	2.83
2004	6,056	17,290	2.85
2005	6,073	18,591	3.06
2006	6,102	18,875	3.09
2007	6,212	17,099	2.75

Figure 2.1 shows the amount of electricity consumed per person on campus in kilowatt hours. Again, there is a peak during fiscal year 2005-2006 of 3,543 kWh per person, and this number drops to 3,153 kWh per person in fiscal year 2006-2007. During the peak, 3.09 metric tons per person of equivalent carbon dioxide were emitted from the production of electricity. Figure 2.2 shows the amount of equivalent carbon dioxide emissions per person on campus from purchased electricity.

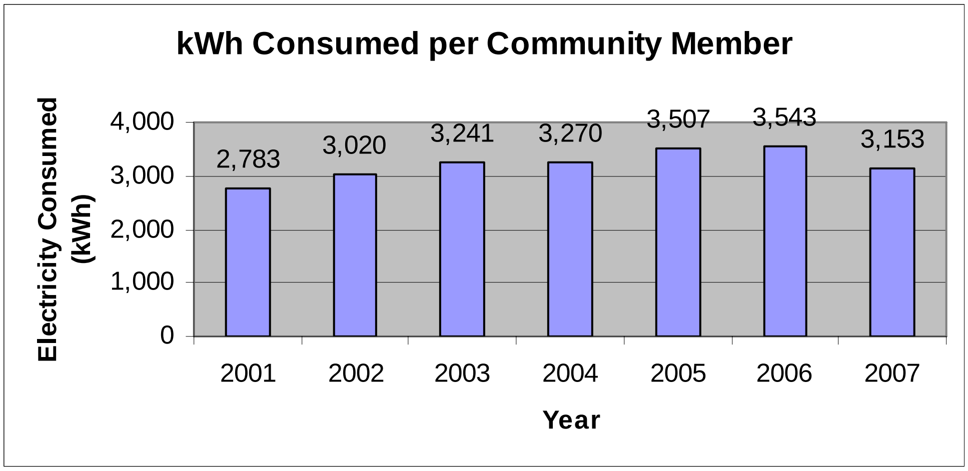

Figure 2.1. Amount of electricity consumed per person at UW-Green Bay

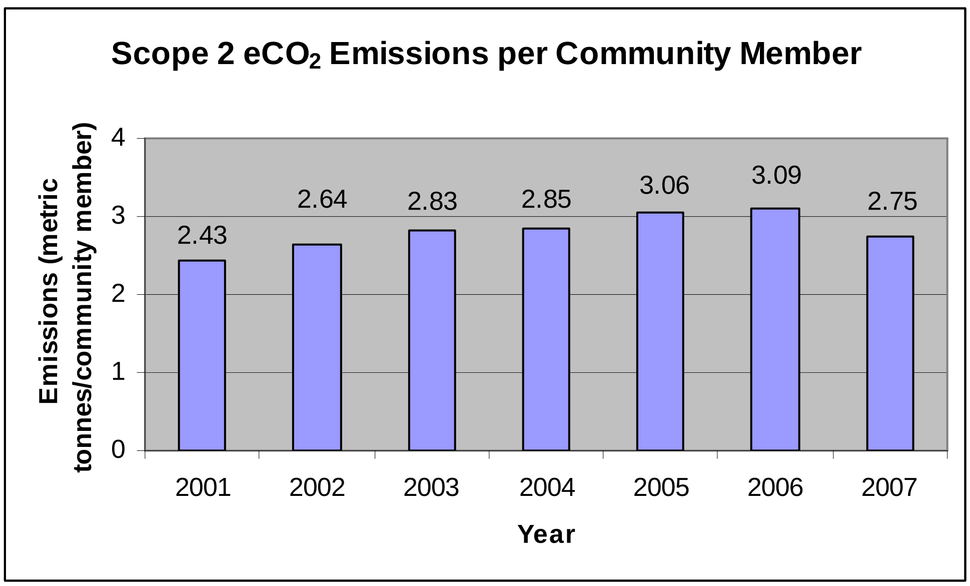

Figure 2.2. Amount of equivalent carbon dioxide emissions per person at UW-Green Bay from purchased electricity

Discussion and Recommendations

This report has been a first step in the determination of the greenhouse gas emissions from the University of Wisconsin-Green Bay. The ACUPCC breaks the emissions down into three scopes. The focus of Scope 2 was to determine greenhouse gas emissions from the production of electricity used on campus. Electricity used by UW-Green Bay is generated off campus and purchased from WPS. This recommendation section is a basic list of some very simple things the campus can do to reduce electricity consumption.

The primary recommendation to the University is the installation of demand controlled ventilation units in all campus buildings. This recommendation was also made by the 2006 capstone class, and we are reiterating the concept. Demand controlled ventilation adjusts the volume of fresh air exchanged in a building or room to real-time occupancy. This is different from typical ventilation systems that are built to allow a specific air exchange rate per person, based upon certain standards. These standards are usually based on carbon dioxide levels within the room. The problem with typical air ventilation systems is that there is no way for the system to determine the actual occupancy of the building or room at any given time. Therefore, the system cannot determine how much carbon dioxide is in the building or room. Ventilation systems are designed to assume the building or room is at maximum occupancy, according to regulations. The standard is 15 cubic feet per minute per person in classroom buildings and 17 cubic feet per minute per person for science laboratories (ASHRAE 2004). A major concern with typical ventilation systems is that any time fresh air is brought into a building or room; it must be tempered to the desired temperature. The tempering of fresh air requires copious amounts of energy that can be avoided by implementing demand controlled ventilation.

Demand controlled ventilation works in the following manner. The system ventilates on a real-time occupancy of the building as measured by carbon dioxide levels. Self calibrating CO_2 detectors are installed in key locations throughout a building, like in return air ducts, lecture halls, and other high occupancy areas. A maximum CO_2 level is set and the system is programmed to ventilate only enough to prevent CO_2 levels from surpassing that set point. The American Society of Heating, Refrigerating, and Air Conditioning Engineers recommends a setpoint of 800 parts per million or less to keep CO_2 levels low enough to prevent any side effects, such as drowsiness (ASHRAE 2004).

According to the analysis conducted by the 2006 capstone class, UW-Green Bay could save an estimated $250,000 to $780,000 in energy costs by installing demand controlled ventilation systems. This is a 52% to 77% savings. Sensors typically cost between $200 and $500 each, and if we assume an average of $300 per sensor, the cost of sensors for the entire campus would be roughly $66,000. It also costs about $1,500 per rooftop unit to install and implement a demand controlled ventilation system, which would be approximately $60,000 for the campus. This brings the total system implementation to about $126,000, with a two to ten month payback.

In addition, the following is a list of ideas that could be implemented on campus to conserve energy. Most of the ideas come from experiences within the Laboratory Sciences building.

- The fume hoods in student laboratories are especially energy intensive. The fume hoods are powered 24 hours per day, 365 days per year. While some hoods need to be operated constantly, such as when chemicals are stored in the hood, others are rarely used. According to a chemistry teaching assistant, the fume hoods are rarely used, maybe four or five times per semester. When the hoods are in use, only one is typically used out of six hoods. This seems like an extreme waste of energy to have all fume hoods constantly running. It would be a good idea to place power switches on the fume hoods to shut them down after use. Perhaps controls could be put in place to power down all but one from each lab at the end of the day and over breaks to reduce power consumption when building occupancy is at a minimum. A timer system might work better since the current ventilation system of the Lab Sciences building relies on the fume hoods to constantly run during the day.

- Buildings that are historically empty overnight could be placed on a timer to adjust the temperature between, say 10 p.m. and 6 a.m. in order to reduce the energy consumption of heating or cooling an unoccupied space.
- Purchase stickers to place by light switches as a reminder to turn the lights off when leaving the room. These should be placed in all campus buildings that have light switches in the room.
- Implement a new system to shut down computers overnight in all offices and computer labs*.
- An improvement is needed for the current software upgrade system where CIT turns on computers in offices to run the upgrades. If the computers could be updated and turned back off when completed, that would save energy*.
- The University needs to implement double sided printing as the default print option on all campus printers. This may not be an electricity conservation initiative, but it is a resource conservation recommendation. This is

recommended for not only computer lab printers, but those within individual department offices, as well.

- Photo sensors are a good idea to install in areas such as hallways where the lights could be turned off when daylight is sufficient to light the space.
- The installation of *Vending Misers* would be great for all vending machines on campus. Vending Misers consist of a motion sensor and the miser device the vending machine plugs into. If no one is near the vending machine for 15 minutes and the compressor is not running, the Vending Miser will turn the machine off. If someone walks by the machine, the motion sensor will sense the movement and send power back to the machine, i.e. turn the light on. The internal thermostat of the vending machine will decide if the compressor needs to come on or not. The Vending Miser does not influence the internal thermostat or the compressor. The Vending Miser also measures ambient room temperature. If the room is very warm, the vending miser will send power to the machine more often than if the machine is in a cold room. The machine will come on every 1-3 hours, even if the motion sensor does not detect movement. This ensures cool beverages, while saving energy by not running so frequently. Vending Misers cost $165 per unit, and the payback can be less than one year.
- One of the easiest ways to reduce energy and water consumption in on-campus housing is to meter the individual apartment or dorm room and make the tenant(s) pay for the bill.

- Combine heat exchangers on exhaust air with demand controlled ventilation. This allows for the recapture of either warm or cool air and reduces the amount of energy consumed.
- Install motion sensors on the lights in the stairwells. This is especially true in Lab Sciences, where the stairwells are fully lit all day long. They are even completely lit on weekends when the occupancy of the building is at a minimum. Placing the lights on a motion sensor will conserve energy, especially overnight, on weekends, and breaks, such as winter or spring break.

*These recommendations have already been discussed and are to be implemented. CIT is going to change the time computers are automatically turned off; going from midnight to 6:30 p.m. The computers will still be turned on to update software, but a shutdown system is to be implemented for when the updates are completed.

Works Cited

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